# EXHIBIT 1

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November 5, 2007

Susan Donahue
Wiggins, Childs, Quinn & Pantazis, P.C.
The Kress Building
301 19th Street North
Birmingham, AL 35203

RE: Bert, et al. v. AK Steel Corporation

Dear Susan:

Enclosed please find the validation studies performed on the AK Steel test.

Sincerely,

Patricia Anderson Pryor

PAP:sls
Enclosures

# CONCURRENT SELECTION TEST VALIDATION STUDY

## of Resource Associates' Aptitude and Personality Tests For Entry Workers at AK Steel, Middletown, Ohio

**August 1997**

## *Overview of This Study*

This document reports the results of a concurrent selection test validation study for the Entry Level employees at AK Steel in Middletown, Ohio. It was undertaken as a second phase of a larger selection testing investigation. The company had recently conducted research to evaluate the validity of aptitude tests they had obtained through a community college. At that point, AK Steel was interested in utilizing the tests and services of Resource Associates, thus this research study was conducted to validate a new set of aptitude tests as well as personality predictors.

This report documents the research efforts that took place to analyze the job family that comprises the several entry-level labor pool positions. Results of the job analysis are then related to based aptitudes and personality factors, which are then translated into recommended measures for use with selection testing. The information thus presented in table format comprises the Content Validity section of the report. Next, the report presents research activities related to administering of test scores and gathering performance data for a concurrent test validation study. Validity coefficients are presented, as are expectancy tables. The conclusions section details tentative plans that AK Steel has discussed in terms of using these tests for selection purposes.

# *Job Analysis*

## Job Analysis Procedures

Several AK Steel employees, listed below, served as Subject Matter Experts for this project.

- Michael J. Lehman, Senior Human Resource Specialist
- Larry Vest, Daytime Manager in the Green Coil Area
- Ed Wicklander, Maintenance Shift Manager
- Russ Honshul, Shift Manager
- Brian Bishop, Maintenance Shift Manager
- Ben Caudill, Supervisor
- Mark Sebald, Supervisor
- Scott Bradstreet, Day Shift Manager, Processing Shipping

During a trip to the AK Steel manufacturing facility in Middletown, Ohio, staff from Resource Associates, Inc., interviewed these Subject Matter Experts about the responsibilities, aptitudes, and behaviors required of employees throughout the facility, toured the plant, observed the work-in-progress, and talked with employees about their job responsibilities. The results of these activities are described in the job analysis section.

## Results of the Job Analysis

In December of 1996 consultants from Resource Associates conducted multiple interviews with both entry level employees and managers of AK Steel in Middletown, Ohio. From these interviews the following information pertaining both to the promotion policy of AK Steel, and to the responsibilities of its employees affected by this promotion policy, was gathered.

Entry level employees of AK Steel are hired into a large labor pool. AK Steel selects employees from this labor pool in order to fill various and essential job positions located throughout the plant in different departments. Employees may also be transferred between departments, depending upon labor shortages and the necessities encountered at various points of the steel production process. Consequently, an entry level employee must be willing and able to work in various departments, requiring of them a cooperative disposition and a wide range of knowledge, skills, and abilities relevant to different parts of the steel production process.

In addition, because AK Steel fills upper level positions by promoting employees only from within the company, a significant percentage of these entry level employees will eventually be needed to occupy upper level job positions. These upper level job positions require employees to assume additional responsibilities and tasks, which can only be met

and performed appropriately via the acquisition of the knowledge, skills, and abilities that are necessary for adequate task performance. As a result, in order to fill the upper level positions of the plant, AK Steel must continually hire, select and promote employees who are willing to acquire additional job relevant knowledge, skills and abilities through continued education and training. The application of this knowledge, and of the job skills and abilities required for job performance, was documented by interviewing and observing employees engaged in the steel production process.

## The following information was gathered from the observations of the work-in-progress within the Melt Shop:

Employees must . . .

- study, understand and apply the Quality Standard Operating Procedures, or QSOPs, which detail the various requirements and procedures of different job positions
- study, understand and apply the Job Health & Safety Analyses, which detail proper protection & safety procedures
- wear protection for the face, neck, and body
- operate ovens and various furnaces which reach temperatures of up to 2400° F
- operate equipment in order to transport ladles of molten steel
- operate all equipment with caution and precision, due to the potential hazards of working with molten steel and near temperatures of extreme heat
- learn and be aware of the dangerous operations and procedures which accompany the creation and transportation of molten steel
- continually monitor computer screens and dials which serve as sources of various types of information relevant to the steel production process
- continually monitor a computer screen which specifies the current level of the molten steel in the ladle
- continually monitor and test temperatures of various production processes
- monitor a display which specifies the degree to which the gate, through which the molten steel pours, is open or closed
- rapidly diagnose the causes of fluctuations in the level of the molten steel
- rapidly diagnose the causes of fluctuations in the rate of flow of the molten steel
- respond independently (i.e., without supervisory instruction) and very quickly (i.e., within seconds), using remote control equipment, to take control of changes in the level of the molten steel
- respond independently (i.e., without supervisory instruction) and very quickly (i.e., within seconds), using remote control equipment, to take control of changes in the rate of flow of the molten steel

- receive and understand information from co-workers pertaining to the level of molten steel and respond to that information very quickly, using remote control equipment, to take control of changes in the rate of flow of the molten steel
- exercise good judgment in making decisions which can have a direct affect on their own lives, as well as those of their co-workers.
- remain very conscientious and aware of the production process at all times to avoid hazardous conditions
- remember and obey, in the presence and absence of supervision, proper safety regulations
- diagnose and understand a dangerous problem under potentially hazardous circumstances
- be able to continually encode, process, and retrieve relevant information under extremely stressful and dangerous circumstances
- be able to act upon the relevant information under extremely stressful and dangerous circumstances
- exercise proper judgment to avoid harm to fellow employees and to self
- have complete knowledge of the appropriate behaviors to be performed under potentially hazardous circumstances
- know when and how to abort the steel production process
- respond independently and rapidly to dangerous situations via the appropriate responses, i.e., firing a blank, using remote controls, pressing the abort button, and turning off certain pieces of production equipment while activating others
- communicate encountered problems with production, as well as potential ones, to the appropriate personnel
- lubricate production equipment with the appropriate amount of powder in order to prevent damage to equipment from the molten steel
- change and apply different types of lubricant, contingent upon the grade of steel in production, to the production equipment
- receive, understand and respond to direct supervisory instructions
- take responsibility for educating new employees, via on-the-job training, as to the various job responsibilities, tasks and proper procedures
- operate fork lifts
- undo the packaging of various products

**The following information was gathered from the observations of the work-in-progress within the Pickling Facility & at the location of the Weighman-Bander:**

Employees must . . .

- receive, read and understand a production schedule detailing the order in which steel coils are to be de-scaled through the hydrochloric acid bath
- decide where to locate coils of steel
- conserve space in the placement and storage of steel coils
- mark the coils with a nine to ten digit identification number
- keep detailed written records as to the location and identification of steel coils
- interface with a computer in order to keep detailed records as to the location and identification of steel coils
- be very accurate and precise in the record keeping process in order to prevent losses in productivity from misplaced coils
- partake in the Quality Control Process by visually inspecting the coils for surface defects
- detect, identify and record different types of flaws in the steel coils
- create written records for both the type and location of the coil damage
- interface with a computer in order to record product damage
- record information in a conscientious and legible fashion for the purpose of communicating this information to other co-workers who must act upon it
- transport the steel coils according to the order of production
- communicate verbally with the crane operator and other co-workers in order to insure the appropriate order of steel coil transportation
- be prepared to deal with problems which may arise from the transportation of the coils
- properly prepare the coil and connect it to several chains for transportation by the crane operator
- attend to the verbal instructions of the inspector who provides information detailing the width of the product
- understand and respond to the instructions of the inspector in order to make proper adjustments to the production equipment
- appropriately adjust the size of the passage through which the steel sheets are to be transported contingent upon verbal information received from the inspector
- receive information via verbal communications with other co-workers regarding different product dispositions and specifications, i.e., steel thickness, length, and width, as well as the order of production
- interface with a computer in order to cross-check the information received from other co-workers as to the different specifications of the product, such as thickness, length, and width, as well as the order of production

- adjust the production process of the coils according to specifications received from both co-workers and the computer
- read, understand, remember, and respond to written instructions which detail adjustments in the production process contingent upon the various coil dispositions and specifications
- obtain an identification ticket from the computer
- attach the identification ticket to the inside of the coil
- be attentive to the order of production and prepare for the incoming coil according to its specifications in order to maintain an adequate rate of production, i.e., 65 to 100 coils per shift
- attend to the spatial relationships between the self, the moving parts of production equipment, the product, and the transport vehicles

**The following information was gathered from interviews with employees and observations of the work-in-progress at the Electrogalvanized Line:**

Employees must . . .

- eventually have knowledge of chemistry and electronics in order to achieve an adequate level of job performance in this department
- be computer literate in order to control the production process
- receive, read and understand a written list of which steel coils must be processed according to the deadlines of production
- verify the information in this list via accessing the corresponding information contained in the computer
- generate from this list the exact order in which steel coils are to be processed
- determine the order of steel coil processing via several parameters and coil specifications, i.e., gauges and width
- record this information into the computer
- record the location of the coil for crane operators
- place on the coil information pertaining to the process order to be used by the crane operator
- locate the appropriate coil according to the recorded coil dimensions, i.e., schedule and stock car numbers
- send steel coils to the appropriate cranes, i.e., to cranes which have the capacity to transport the coil, otherwise extensive damage can be done to equipment that is essential to the production process
- operate a crane via remote controls in order to lift and transport the steel coils
- encode and store information relevant to the weight of the coil and the corresponding cranes which have the capacity to transport the coil
- double-check the coil dimensions

- retrieve the above information under stressful working conditions, i.e., under conditions of production deadlines, noise, a re-ordering of the production of coils, breakdowns on the production line, etc.
- carefully avoid damage to the product which can cause costly and severe down-time in the production process
- remain cooperative under conditions in which damage to the product has occurred, causing work-place stress and a re-ordering of the line of production
- locate another unprepared (i.e., unexposed) coil which meets the appropriate specifications under the conditions of coil damage
- prepare the coil by removing the protection equipment from the coil, e.g., cut the bands from the coil, remove packaging material
- use a remote control panel to operate the conveyor belt upon which the coils are placed for transportation

**The following information was gathered from interviews with employees and observations of the work-in-progress at the Coating and Shipping Lines:**

Employees must . . .

- wear protection for the face, neck, and body
- be able to drive a tow motor
- lift steel bars (30 to 50 pounds) and place them into a furnace approximately every 10 to 15 minutes
- maintain approximately 20 pounds of steel production per minute
- monitor temperature limits of the furnace to determine when it can be fed with the steel bars
- adjust the temperature to control the rate of feeding
- read and understand a list detailing the order in which coils are to be processed
- visually inspect the coil, acquiring information as to the gauge and width of the coil to insure that the correct one will be processed
- prepare coils to be unwrapped
- enter the parameters of the coil into a computer
- carefully monitor the unwrapping of the steel coil to insure that it is not done completely, i.e., part of the steel must remain wrapped
- attend to the spatial relationships between the coil and the equipment in order to move it properly via remote controls
- perform multiple tasks simultaneously, i.e., attend to the computer monitor, remote controls, and the coil at the same time

- read and interpret written information pertaining to the coil characteristics and the order of production, as well as the pieces that must be cut out from the product
- record the identification of the coil onto the coil itself and into the computer
- stop the motion of the steel coil
- weld the ends of two separate coils together
- interface with a computer to determine the proper packaging for a steel coil
- receive and give verbal communications which pertain to the packaging requirements of a coil
- have knowledge of the fact that there are approximately 400 different types of packaging specifications
- accurately identify and locate particular steel coils
- measure these coils to determine their parameters
- use information obtained from the computer, co-workers, and measurements of the coil itself in order to band and package the coil appropriately
- use coil parameters, e.g., weight, width, diameter, in order to determine the packaging requirements of each coil
- obtain knowledge of the customer's specifications from co-workers and computers in order to determine the packaging requirements of each coil
- apply this information with care and accuracy when packaging the coil according to customer specifications and regulations
- apply oil to the coil if required according to customer specifications
- receive both written and verbal instructions from co-workers pertaining to the fashion in which the coil is to be tagged and identified, i.e., the location of tag placement and how many are needed
- place identifying tags on the coil according to customer specifications, i.e., inside of the coil or outside on the packaging, depending upon the customer's needs and specifications
- package the coil correctly the first time, incorrect packaging can waste materials, decrease production time, and potentially damage customer relations
- detect any defects in the product prior to shipping
- be physically fit; packaging a coil can be a physically demanding process
- transport the coil via remote controls
- work in a team-based environment

**The following information, which pertains to the job performance and knowledge required from those at upper-level positions throughout the plant, was gathered from interviews with Subject Matter Experts, as well as from observations of the work-in-progress of these upper-level employees:**

Because approximately 45% of entry level workers are eventually employed by the Maintenance Department, AK Steel must hire individuals who are willing and able to acquire, understand, and act upon knowledge of chemistry, electronics, hydraulics, mechanics, and other areas of academic specialization. Interviews with individuals employed in this department, as well as with others, and observations of the work-in-progress of upper-level employees throughout the plant, revealed that upper-level positions in AK Steel require many of the incumbents to . . .

- have knowledge of chemistry in order to achieve an adequate level of job performance
- have knowledge of electronics in order to achieve an adequate level of job performance
- have knowledge of hydraulics in order to achieve an adequate level of job performance
- use mathematical equations
- communicate complicated problems with various machinery to other employees
- have knowledge of DC Theory, especially in order to work on cranes
- understand cause and effect in order to rapidly diagnose and repair problems with machinery for the purpose of avoiding serious losses in productivity
- be able to make quick and accurate decisions regarding machinery repair
- be willing to learn in both the classroom and on-the-job in a mentor-student relationship, i.e., an apprenticeship
- be very computer literate and adept in order to control and record the steel production process
- engage in independent trouble-shooting for equipment maintenance and repair
- understand and apply an extensive amount of knowledge learned during the apprenticeship
- think logically, i.e., in terms of cause and effect for proper diagnosis of production problems
- diagnose and correct the causes of production problems rapidly because delays in production are extremely costly
- be observant as to the different symptoms of machine wear, which signal different causes, and, consequently, different solutions as to the appropriate repair procedures
- keep multiple pieces of information in mind when solving a problem, while attending to both safety and speed

- record every delay in production greater than 4 minutes
- inspect both sides of steel coils for surface defects
- identify steel coils and place proper protection on them accordingly
- know how to manually set up the equipment necessary for the production process under the condition in which the computers break down, and use this information for adequate levels of job performance at the appropriate times
- detect flaws in the steel coils and determine what caused those flaws
- measure the distance from one defect to the other in order to see if this distance matches the parameters of the processing equipment, which serves to determine and/or eliminate one possible cause of the defect
- independently troubleshoot problems with production equipment and the product
- determine and set the number of coils to be processed
- continually interface with a computer via observing the screen monitor or recording information via the keyboard
- continually attend to spatial relationships between the product and the processing equipment
- respond to the different parameters of different steel coil products by adjusting the processing equipment either manually or via computer controls
- understand, control and operate hydraulic equipment
- operate multiple pieces of equipment while monitoring computer screens in order to control the rate of steel coil production
- interface with a computer to record all production information, including records of product tests and defects
- inspect each coil to acquire information pertaining to multiple product characteristics in order to determine how it must be processed, requiring continual flexibility of judgment
- integrate product and production variables for the purpose of determining the proper adjustments of production equipment
- change tasks when needed, requiring flexibility and multi-tasking capabilities
- engage in Quality Control procedures, continually comparing the current coil to specified product parameters
- interact in a cooperative fashion with supervisors, subordinates, co-workers and members of other departments
- observe and learn from the actions of their mentors on-the-job
- think in holistic terms, integrating the information in their department with that from others
- have leadership qualities, i.e., teach subordinates and apprentices different aspects of the steel production process
- understand how one process in one part of the plant, if adjusted, affects processes throughout the rest of the plant
- insure the product is processed according to specifications, adjusting equipment and furnace temperatures accordingly

- be willing to continually engage in verbal communications with employees at all levels of the department

## Subject Matter Experts' Descriptions of Job Incumbents:

Subject Matter Experts described job incumbents of all levels as needing to be . . .

- highly conscientious and observant of safety regulations in the absence of direct supervision
- cooperative and agreeable in order to avoid work place arguments which can slow the production process
- able to remain calm and competent, making correct decisions under potentially hazardous circumstances
- achievement motivated, i.e., high in work-drive and willing to be promoted when called upon
- high in work-drive, i.e., someone who desires to increase their own level of job performance by increasing their own level of productivity, and the productivity of their co-workers
- customer oriented, i.e., meeting the needs of the customer with perfection when packaging the final product
- able and willing to troubleshoot production problems independently
- ambitious, someone who desires to move up the job ladder in order to fill vacant positions of responsibility in the steel plant essential to its operation
- willing and eager to take on the added responsibilities that come from promotions to higher job levels -- not lazy
- resilient in that they are not easily influenced by the negative attitudes of others
- open to new experiences and ideas, largely because many of the upper level job positions in the plant require employees to attend classes in order to gain the knowledge of chemistry, electronics, and hydraulics, etc., necessary for adequate levels of job performance
- willing to learn new job skills and to acquire new information
- willing to cooperate with co-workers and supervisors
- willing to follow directions
- someone who wants to remain productive, i.e., want to increase the speed and quality of production, and acts on this desire by preparing for the next steel coil when time is available, instead of taking breaks
- disciplined and respectful of authority
- willing to follow the rules and regulations
- punctual, someone who wants to come to work and who disapproves of unauthorized absenteeism -- not a clock pusher

- have the capacity to engage in abstract reasoning for the purpose of independent troubleshooting activities, i.e., understanding the antecedents of a production problem and its consequences
- inquisitive and curious about the production process, i.e., someone who wants to learn how different departments are connected and inter-dependent
- have a high level of verbal fluency, continually communicating aspects of the production process to managers, supervisors, subordinates, and peers
- able to teach others via good social and communication skills
- holistic in their thinking, i.e., able to understand how changes in the steel production process in one part of the plant affect the product processes in the rest of the facility

# *Content Validity Matrix*

The above information allowed for the creation of the following table, which documents the selection tests that were chosen. These tests were chosen on the basis of the aptitudes that were determined as important for adequate levels of job performance, and the way in which those aptitudes were used in the performance of job tasks.

| Task | Aptitude | Test |
|---|---|---|
| Employees must read, study, understand and apply the Quality Standard Operating Procedures, or QSOPs, which detail the various requirements and procedures of different job positions. Employees must read, study, understand and apply the Job Health & Safety Analyses, which detail proper protection & safety procedures. They must also associate this information with different pieces of production equipment and different plant locations. Employees must read and interpret written information pertaining to the coil characteristics and the order of production. Employees must read texts which pertain to the principles of chemistry, hydraulics and electronics. | Reading and comprehension of written material. | SRA Reading Index |
| Employees must independently troubleshoot problems with production equipment and the steel products. Employees must think logically, in terms of cause and effect for proper diagnosis of production problems. Employees must diagnose and correct the causes of production problems rapidly because delays in production are extremely costly. | Independent Problem Solving | Work Sample Test of Independent Problem Solving |

| Task | Aptitude | Test |
|---|---|---|
| Employees must continually monitor temperature indicators, making adjustments in temperature controls when necessary. Employees must keep extensive records, logs, and other written communications accurate and up-to-date. Employees must remain attentive for extensive periods of time to the operations of various equipment and the displays of computer monitors. Employees must follow rules, safety regulations, and production guidelines on a regular consistent basis in a standardized fashion. | Conscientiousness and Attention to Detail | RA Personal Style Inventory (version c6c)<br><br>and / or 16 PF |
| Employees must desire promotion, and the competencies that promotion requires, if vacant upper-level job positions essential to the production process are to be filled. Many employees must strive to learn a substantial amount of material to successfully complete training requirements. The amount of work done by individual employees has a great impact on other steel production processes located throughout the plant, and on company productivity in general. They must strive to remain productive if serious disagreements between co-workers and costly loses in productivity are to be avoided. | Achievement Motivation and Work Drive | RA Personal Style Inventory (version c6c)<br><br>and / or 16PF |
| Employees must cooperate in a collective fashion to insure that all workstations are covered adequately, and that directions from management are communicated to co-workers and followed. As a result, employees must maintain good working relationships, prevent rivalries, keep friendships from creating rifts, and avoid and/or ignore annoyances all in order to maintain a high level of product quality and production. | Emotional Stability | RA Personal Style Inventory (version c6c)<br><br>and / or 16PF |

| Task | Aptitude | Test |
|---|---|---|
| Employees may be called upon to work in different departments and in a variety of different job positions. Employees must be able to adapt to new changes in technology and production equipment. Task responsibilities can change from day-to-day depending upon the number of employees present, the nature of their training, and the current workload. Many employees are responsible for attending classes and participating in on-the-job training to acquire new knowledge, skills, and abilities necessary for adequate levels of job performance. | Openness to Experience | RA Personal Style Inventory (version c6c)<br><br>and / or 16 PF |
| Employees must serve as liaisons via face-to-face interactions with management, quality, safety, maintenance and other personnel. Many employees must work in a social team-based environment. | Extroversion | RA Personal Style Inventory (version c6c)<br><br>and / or 16 PF |
| Employees must remain cooperative under conditions in which damage to the product has occurred, causing work-place stress and a re-ordering of the line of production. Employees must be willing to continually engage in verbal communications with employees at all levels of the department. Employees must interact in a cooperative fashion with supervisors, subordinates, co-workers and members of other departments. Employees must also be willing to learn on-the-job in a mentor-student relationship. | Sociability and Agreeableness | RA Personal Style Inventory (version c6c)<br><br>and / or 16 PF |
| Employees must be willing to subject themselves to sometimes dangerous environments, and act in accordance with safety regulations to minimize potential for accidents, but still be willing to work around molten metal and heavy equipment in harsh conditions of extreme heat and cold. | Tough-Mindedness | 16 PF |

| Task | Aptitude | Test |
|---|---|---|
| Employees must detect visual defects to both the product and the production equipment. Employees must inspect the steel coils for visual defects at multiple locations on the production line. Detection of these defects must be accomplished in a timely fashion to maintain customer satisfaction, and to avoid costly delays in the production process | Visual Acuity | RA Visual Inspection Test |
| Employees must attend to spatial relationships between the self, the product, and the production equipment. Many employees must be able to conduct manual machine set-ups during computer down time. Many employees must take apart and reassemble intricate machinery and production equipment. | Spatial Perception and Reasoning Ability | RA 3-D Spatial Reasoning Test and / or Form Pattern Perception Test |
| Employees must think logically, in terms of cause and effect, for the proper diagnosis of production problems with the product and/or the production equipment. Employees must understand how changes in the production process at one end of the plant can affect the steel production processes in other plant areas. Employees must exercise good judgment in making decisions which can have a direct affect on their own lives, and those of their co-workers. Employees must understand how their actions translate to company profitability. | Abstract Reasoning | Pattern Series Test |

| Task | Aptitude | Test |
|---|---|---|
| Employees must understand temperature, product measurements, and equipment controls, all of which are based on numerical scales. Many employees must use numerically controlled machine tools. Many employees must use addition, subtraction, division, multiplication, calculations of averages, and other mathematical functions in order to acquire the level of knowledge in chemistry, hydraulics, and electronics necessary for adequate levels of job performance. | Numerical Reasoning | RA Math for Industry |
| Employees must independently troubleshoot mechanical and electrical problems with the production machinery. Many employees perform maintenance work involving complex interlocking and/or interrelated electronic circuits. Many employees must tear down, repair, and reassemble intricate equipment essential to the production process. | Mechanical Aptitude and Reasoning Abilities | RA Mechanical Reasoning Test |

# *Procedures for This Study*

## Tests Selected For This Study

After discussion of the job analysis findings with our contacts at AK Steel, several tests were selected to include in the validation study. They are:

- Resource Associates Pattern Series Test of Abstract Reasoning
- Resource Associates Mechanical Reasoning Test
- Resource Associates Math Test for Industry
- Resource Associates Reading for Production Workers Test
- Resource Associates 3-D Visual Spatial Reasoning Test
- Resource Associates Form Pattern Comprehension Test
- Resource Associates Industrial Personal Style Inventory (version C6C)

## Gathering Test Score Data

Employees whose scores comprised the basis for the previous validity study served as the sample for this concurrent validity study as well. One of the human resources staff members informed these participants of the appropriate time and place to complete the above tests. Staff from the Human Resource Department of AK Steel scheduled the people and administered all the tests to the concurrent validation sample. The completed answer sheets were then sent to Resource Associates for scoring, data entry and statistical analysis.

It should be noted that during the test administration process many of the participants informed personnel of the Human Resource Department of AK Steel that they had not taken the testing session seriously. Some indicated that they had deliberately misrepresented themselves. This behavior of the participants greatly increased the error present in their item responses and test scores. Because variables tainted with error, especially random variables, tend not to correlate with criterion measures, we anticipated that it would be extremely difficult to demonstrate validity of the selection tests.

If test scores, collected under the above conditions, correlate with measures of job performance, they do so in spite of the error present in the database, and are not aided by the presence of error. Hence, when test scores tainted with error in the above fashion, do significantly correlate with measures of job performance, those measurements represent the lower-bound estimates of the strength of the relationships between individual differences in cognitive ability and/or personality, and individual differences in job performance.

## Gathering Performance Rating Data

The criterion that was used in the predictive validity study were also used in the current study. These dimensions were based on extensive input from representative supervisors and managers. They represent the key dimensions of performance for entry-level workers. Human Resources staff members personally communicated with a large number of supervisors to identify (a) the best people to provide ratings for a specific employee, and (b) to actually secure the performance rating data. In many cases, performance rating forms were obtained from more than one supervisor.

The form was composed of 13 dimensions, each with accompanying behavioral descriptions. The dimensions used for performance ratings in this study were:

1. Ability to learn and reason
2. Job Skills and Proficiency
3. Initiative
4. Productivity
5. Quality
6. Safety
7. Teamwork
8. Reliability
9. Relationship with Supervision
10. Function under stress
11. Attendance and Tardiness
12. Advancement
13. Overall Rating

The rating scale used for these dimensions were:

1. Does not meet, or rarely meets, minimum job standards.
2. Is less than satisfactory in many respects.
3. Is satisfactory in most respects, but not all.
4. Is satisfactory in all respects.
5. Is above average, but not superior.
6. Is superior in almost all respects.
7. Is definitely superior in all respects.
8. Single best performance I have ever observed, or hope to observe.

## Data Analyses

Completed test answer sheets were forwarded to Resource Associates where they were scored and entered into a computerized database. Industrial Psychologists at Resource Associates conducted the statistical analyses using SPSS (Statistical Package for the Social Sciences).

Because of evidence that employees had intentionally misrepresented themselves on the tests and personality measures, we were extremely concerned about the integrity of the data set. Therefore, each set of test scores in the data set was evaluated. Those cases that appeared to be invalid were purged from the sample. First, where "runs" of one response were present, we felt that people had not responded to the items in any meaningful way; they had probably just marked any answer. Second, for each scale in the personality inventory, discrepancy scores were calculated to determine what appeared to be random or willful manipulation of the responses. For example. if a person agreed with the response "My mood goes up and down more than most people" yet also agreed that "I never get depressed about the way things are going in my life" this would demonstrate a discrepancy. Normally, people agree to similar items in a scale. Therefore, discrepancy scores were calculated on each scale for each person. Those cases where a high degree of unreliability was present were dropped from the sample. In all, 25 cases were eliminated out of 101, leaving a total usable sample of 76.

# *Results of the Concurrent Validation Study*

## Descriptive Statistics for the Validation Sample

This sample consisted of 76 linked sets of data: test scores with performance ratings. Of that number, 70 (92%) were males and 6 (8%) were female. These entry-level workers had been on the job for approximately one to two years and worked in various locations throughout the mill depending on where they were needed that day. No data was available for race or age.

## Validity Analyses

Pearson product moment corrections were computed to assess validity of the tests in relation to performance ratings. One-tailed significance tests at the .05 level of significance were run to evaluate whether there was a valid relationship between the test scores (predictors) and the performance ratings (criterion measures).

A correlation coefficient is interpreted as a "validity coefficient." Validity is demonstrated when a positive correlation exists between the test score and the criterion measure. Only those correlations that are strong enough (ones that are identified as significant) are deemed to reflect practical consideration. Among scientists, if a statistic is viewed as occurring by chance less than 5 times out of 100 similar trials, then it is judged to be significant ($p<.05$). If the significance is greater than .05 then the statistic is viewed as reflecting only random error.

In addition to correlating each set of test scores with an average performance rating on each dimension, we also created a single factor "Overall Performance Rating" by averaging all categories of ratings for each person, as mentioned earlier.

## *Validity Analyses of the Aptitude Measures*

As shown in the following table, a very respectable set of validity coefficients emerged from this data set. All of the aptitude tests demonstrated significant correlations with at least several of the criterion measures.

The most consistent pattern of results can be seen in the correlations between the test scores and the Ability to Learn and Reason. Likewise the correlations with regard to Quality of Work, Job Skills Competencies and Productivity are solid.

In looking at the pattern of results for the Average Rating or Overall Summary Rating, the results are again very positive. The most striking set of results is seen in the final column where the six aptitude test scores were standardized and averaged. These correlations are quite substantial and support the use of aptitude tests for predicting job candidates who can be expected to perform up to standards on the job.

This is strong evidence of the predictive power of aptitude tests to predict criteria having to do with being able to pick up new information quickly, being able to handle complexity, and being able to grow with additional job responsibilities. Given that a majority of employees are expected to progress into much higher level jobs within the company at AK Steel, they will have to learn new information consistently to be able to handle the more responsible jobs. These data demonstrate that aptitude is a valid predictor for entry-level jobs. While this study did not gather data from people in higher level jobs, published research provide ample support for aptitude being an even stronger predictor in the more cognitively complex jobs.

## Test Criterion Correlation Measures (Validity Coefficients) for the Aptitude Measures

| Rating Dimension | Mechanical Reasoning Test | Industrial Math Test | Industrial Reading Test | Abstract Reasoning Test |
|---|---|---|---|---|
| Ability to Learn | .26** | .35** | .39** | .35** |
| Initiative | .29** | .12 | .21* | .21* |
| Quality of Work | .29** | .28** | .22* | .26** |
| Job Skills Competencies | .33** | .24* | .26** | .23* |
| Productivity | .24** | .18* | .25** | .33** |
| Safety | .17 | .11 | .19* | .22* |
| Reliability | .16 | .11 | .11 | .25** |
| Stress Tolerance | .17 | .18* | .25** | .19* |
| Willingness to Advance | .19* | .27** | .19* | .12 |
| Teamwork | .24* | .12 | .12 | .17 |
| Supervisory Relations | .15 | .15 | .12 | .07 |
| Attendance | .06 | .11 | .06 | .08 |
| Overall Rating | .28* | .19* | .23* | .14 |
| Average Rating | .29** | .16 | .18 | .23* |

* p < .05 significance ** p < .01 significance

| Rating Dimension | 3-D Reasoning Test | Form Pattern Test | Average of All Six Standardized Test Scores |
|---|---|---|---|
| Ability to Learn | .33** | .21* | .36** |
| Initiative | .32** | .15 | .33** |
| Quality of Work | .26** | .1* | .36** |
| Job Skills Competencies | .30** | .17 | .37** |
| Productivity | .27** | .24* | .39** |
| Safety | .24* | .09 | .24* |
| Reliability | .30** | .10 | .26** |
| Stress Tolerance | .31** | .16 | .31** |
| Willingness to Advance | .26** | .16 | .26** |
| Teamwork | .21* | .08 | .25* |
| Supervisory Relations | .14 | .08 | .15 |
| Attendance | .15 | .03 | .14 |
| Overall Rating | .14 | .15 | .27* |
| Average Rating | .25** | .18* | .32** |

* < .05 significance ** < .01 significance

### *Validity Analyses of the Personality Measures*

This analysis produced a reasonable pattern of validity coefficients for the personality measures. While all the dimensions were shown as valid predictors of at least one criterion measure, several were much stronger predictors than others:

- Conscientiousness (rules orientation, willingness to adhere to company regulations) – People who score high are shown to be more able to pick up new information quickly, show more initiative, achieve a higher quality of work, are more competent in their job skills, are more productive, are more tolerant of work stress, are more likely to show a willingness to advance and take on new responsibilities. In addition, they are rated as outstanding by their supervisors.
- Emotional Stability (maturity, level-headedness). People who score high are very similar to those who score high on conscientiousness, but they are also good team players.
- Agreeableness (being cooperative, helpful, good citizen). People scoring high on Agreeableness are more likely to be able to learn on the job, develop good job skills, are seen as reliable and tolerant of stress, and they are willing to advance into expanded job responsibilities.

The other personality dimensions did achieve at least one significant validity coefficient in the data set but the results were much less consistent.

- Openness to New Experience. People scoring high are more likely to pick up new information well and gain knowledge from co-workers as well as on-the-job experiences.
- Extroversion: People who are more outgoing tend to pick up a lot of information easily, whether by learning from co-workers or by attending training classes. They have good job skills and are productive workers.
- Work Drive: People scoring high gain more knowledge about their jobs, have more initiative, and willingness to advance.
- Customer Responsiveness: People scoring high make good team members because they are responsive to others' needs and they are willing to cooperate and collaborate.

## Validity Coefficients for the Personality Measures

| Rating Dimension | Conscientiousness | Emotional Stability | Agreeableness | Openness |
|---|---|---|---|---|
| Ability to Learn | .32** | .29** | .26** | .26** |
| Initiative | .24** | .26** | .11 | .11 |
| Quality of Work | .21* | .21* | .13 | .13 |
| Job Skills Competencies | .21* | .25** | .26** | .15 |
| Productivity | .21* | .30** | .30** | .14 |
| Safety | .10 | .15 | .16 | .04 |
| Reliability | .15 | .17 | .26** | .08 |
| Stress Tolerance | .24** | .23* | .22* | .08 |
| Willingness to Advance | .23* | .22* | .21* | .06 |
| Teamwork | .14 | .19* | .23* | .11 |
| Supervisory Relations | .16 | .14 | .13 | .03 |
| Attendance | .11 | .06 | .10 | .03 |
| Overall Rating | .14 | .11 | .22* | .01 |
| Average Rating | .21* | .19* | .21* | .06 |

* p < .05 significance p < .01 significance

| Rating Dimension | Extroversion | Work Drive | Customer Responsiveness |
|---|---|---|---|
| Ability to Learn | .36** | .29** | .14 |
| Initiative | .15 | .22* | .14 |
| Quality of Work | .11 | .17 | .08 |
| Job Skills Competencies | .19* | .24 | .14 |
| Productivity | .21* | .16 | .16 |
| Safety | .06 | .11 | .16 |
| Reliability | .11 | .12 | .14 |
| Stress Tolerance | .11 | .14 | .08 |
| Willingness to Advance | .13 | .22* | .13 |
| Teamwork | .13 | .14 | .20* |
| Supervisory Relations | .07 | .14 | .07 |
| Attendance | .04 | .14 | .10 |
| Overall Rating | .14 | .08 | .08 |
| Average Rating | .09 | .19* | .11 |

p < .05 significance ** p< .01 significance

## Expectancy Analyses

One way to illustrate the potential value of these tests and measures is to examine the performance ratings of individuals with different levels of aptitude. For example, we can use the Overall Cognitive Aptitude score, and group each of the AK Steel Entry-Level employees participating in the validation study into, say, three groups representing the upper, middle, and lower third categories on the Overall Cognitive Aptitude Scores. Next, we can record the percent of these employees in each group who received a superior performance rating of 5.75 or higher on Average Performance Rating, reflecting their achievement of superior job performance at AK Steel

**Percent of the Sample**
**in each of Three Overall Aptitude Score Groups**
**Who Were Rated as Superior**

| Overall Aptitude Scores | Average Job Performance Rating (Percent Who Were Rated as Superior) |
|---|---|
| Lower One-Third | 20% |
| Middle One-Third | 34% |
| Upper One-Third | 57% |

It can be seen that the odds of a person being rated as superior on the Overall Performance Rating Dimension increases substantially as we move from the lower one-third of the validation sample to the upper one-third on the Overall Cognitive Aptitude.

Likewise, we can look at the performance ratings with regard to scores on the personality dimensions. First, an expectancy table was created using an average of all the personality variables: Conscientiousness, Emotional Stability, Agreeableness, Openness to New Experience, Extroversion, Work Drive, and Customer Responsiveness.

**Percent of the Sample**
**in each of Three Overall Personality Score Groups**
**Who Were Rated as Superior**

| Overall Personality Scores | Average Job Performance Rating (Percent Who Were Rated as Superior) |
|---|---|
| Lower One-Third | 35% |
| Middle One-Third | 40% |
| Upper One-Third | 42% |

Next, we looked at how the performance ratings would be apportioned based on three categories of personality variables when only the three strongest variables were included: Conscientiousness, Emotional Stability, and Agreeableness. In this case, we see that when these three personality variables are used to categorize the sample, the results are quite striking—75% of the people who place in the upper third were rated as outstanding!

**Percent of the Sample in each of Three Personality Score Groups Who Were Rated as Superior**

| Overall Aptitude Scores | Average Job Performance Rating (Percent Who Were Rated as Superior) |
|---|---|
| Lower One-Third | 35% |
| Middle One-Third | 38% |
| Upper One-Third | 75% |

# *Conclusions and Recommendations*

This study documented the job analysis for entry-level jobs at AK Steel. Based on observations of work-in-progress and discussions with subject matter experts, we were able to generate information to support content validity of a set of aptitude tests and personality factors.

The concurrent validation study that was conducte_ was impaired by not having a larger sample. The small sample available to us limited statistical power. Then, the fact that current employees were not cooperative or mature in taking the tests further limited chance to demonstrate validity.

Nevertheless, when the data were analyzed a respectable set of validity coefficients emerged. Each one of the aptitude tests was shown to be a valid predictor of job performance. All of the personality measures also validated with at least one or more of the performance criteria.

In moving forward to utilize selection testing for actual job candidates, AK Steel will need to determine whether they want to include all of these aptitude tests and personality measures in a test battery. Next AK Steel needs to decide whether a cutoff score should be instituted and at what point it should be set.

# PREDICTIVE SELECTION TEST VALIDATION STUDY

**FOR ENTRY LEVEL POSITIONS**
**at AK Steel**
**Middletown, Ohio**

**May 1997**

## *Background*

In Fall 1996, AK Steel began the process of enhancing its applicant testing system. Approximately two years previously, AK Steel initiated the use of standardized testing for entry-level job candidates using the tests and services of test experts from the local college. During this period, approximately 200 individuals were hired using scores from the standardized test as the basis for one key component of the hiring decision.

At this point, however, AK Steel determined that a more substantial test validation effort should be conducted on the tests they had been using. Representatives from the community college had attested as to the validity of the selection tests. After contracting with the Industrial Psychologists at Resource Associates, Inc., it was decided that test scores for people hired over the past two years would be analyzed in relation to current job performance.

## *Job Analysis*

Several AK Steel employees, listed below, served as Subject Matter Experts for this project.

- Michael J. Lehman, Senior Human Resource Specialist
- Larry Vest, Daytime Manager in the Green Coil Area
- Ed Wicklander, Maintenance Shift Manager
- Russ Honshul, Shift Manager
- Brian Bishop, Maintenance Shift Manager
- Ben Caudill, Supervisor
- Mark Sebald, Supervisor
- Scott Bradstreet, Day Shift Manager, Processing Shipping

During a trip to the AK Steel manufacturing facility in Middletown, Ohio, staff from Resource Associates, Inc., interviewed these Subject Matter Experts about the responsibilities, aptitudes, and behaviors required of employees throughout the facility, toured the plant, observed the work-in-progress, and talked with employees about their job responsibilities. The results of these activities are described in the job analysis section.

## *Results of the Job Analysis*

In December of 1996 consultants from Resource Associates conducted multiple interviews with both entry level employees and managers of AK Steel in Middletown, Ohio. From these interviews the following information pertaining both to the promotion policy of AK Steel, and to the responsibilities of its employees affected by this promotion policy, was gathered.

Entry level employees of AK Steel are hired into a large labor pool. AK Steel selects employees from this labor pool in order to fill various and essential job positions located throughout the plant in different departments. Employees may also be transferred between departments, depending upon labor shortages and the necessities encountered at various points of the steel production process. Consequently, an entry level employee must be willing and able to work in various departments, requiring of them a cooperative disposition and a wide range of knowledge, skills, and abilities relevant to different parts of the steel production process.

In addition, because AK Steel fills upper level positions by promoting employees only from within the company, a significant percentage of these entry level employees will eventually be needed to occupy upper level job positions. These upper level job positions require employees to assume additional responsibilities and tasks, which can only be met and performed appropriately via the acquisition of the knowledge, skills, and abilities that are necessary for adequate task performance. As a result, in order to fill the upper level positions of the plant, AK Steel must continually hire, select and promote employees who are willing to acquire additional job relevant knowledge, skills and abilities through continued education and training. The application of this knowledge, and of the job skills and abilities required for job performance, was documented by interviewing and observing employees engaged in the steel production process.

**The following information was gathered from the observations of the work-in-progress within the Melt Shop:**

Employees must . . .

- study, understand and apply the Quality Standard Operating Procedures, or QSOPs, which detail the various requirements and procedures of different job positions
- study, understand and apply the Job Health & Safety Analyses, which detail proper protection & safety procedures
- wear protection for the face, neck, and body
- operate ovens and various furnaces which reach temperatures of up to 2400° F
- operate equipment in order to transport ladles of molten steel
- operate all equipment with caution and precision, due to the potential hazards of working with molten steel and near temperatures of extreme heat
- learn and be aware of the dangerous operations and procedures which accompany the creation and transportation of molten steel
- continually monitor computer screens and dials which serve as sources of various types of information relevant to the steel production process
- continually monitor a computer screen which specifies the current level of the molten steel in the ladle
- continually monitor and test temperatures of various production processes
- monitor a display which specifies the degree to which the gate, through which the molten steel pours, is open or closed
- rapidly diagnose the causes of fluctuations in the level of the molten steel
- rapidly diagnose the causes of fluctuations in the rate of flow of the molten steel
- respond independently (i.e., without supervisory instruction) and very quickly (i.e., within seconds), using remote control equipment, to take control of changes in the level of the molten steel
- respond independently (i.e., without supervisory instruction) and very quickly (i.e., within seconds), using remote control equipment, to take control of changes in the rate of flow of the molten steel
- receive and understand information from co-workers pertaining to the level of molten steel and respond to that information very quickly, using remote control equipment, to take control of changes in the rate of flow of the molten steel
- exercise good judgment in making decisions which can have a direct affect on their own lives, as well as those of their co-workers.
- remain very conscientious and aware of the production process at all times to avoid hazardous conditions

- remember and obey, in the presence and absence of supervision, proper safety regulations
- diagnose and understand a dangerous problem under potentially hazardous circumstances
- be able to continually encode, process, and retrieve relevant information under extremely stressful and dangerous circumstances
- be able to act upon the relevant information under extremely stressful and dangerous circumstances
- exercise proper judgment to avoid harm to fellow employees and to self
- have complete knowledge of the appropriate behaviors to be performed under potentially hazardous circumstances
- know when and how to abort the steel production process
- respond independently and rapidly to dangerous situations via the appropriate responses, i.e., firing a blank, using remote controls, pressing the abort button, and turning off certain pieces of production equipment while activating others
- communicate encountered problems with production, as well as potential ones, to the appropriate personnel
- lubricate production equipment with the appropriate amount of powder in order to prevent damage to equipment from the molten steel
- change and apply different types of lubricant, contingent upon the grade of steel in production, to the production equipment
- receive, understand and respond to direct supervisory instructions
- take responsibility for educating new employees, via on-the-job training, as to the various job responsibilities, tasks and proper procedures
- operate fork lifts
- undo the packaging of various products

**The following information was gathered from the observations of the work-in-progress within the Pickling Facility & at the location of the Weighman-Bander:**

Employees must . . .

- receive, read and understand a production schedule detailing the order in which steel coils are to be de-scaled through the hydrochloric acid bath
- decide where to locate coils of steel
- conserve space in the placement and storage of steel coils
- mark the coils with a nine to ten digit identification number
- keep detailed written records as to the location and identification of steel coils
- interface with a computer in order to keep detailed records as to the location and identification of steel coils

- be very accurate and precise in the record keeping process in order to prevent losses in productivity from misplaced coils
- partake in the Quality Control Process by visually inspecting the coils for surface defects
- detect, identify and record different types of flaws in the steel coils
- create written records for both the type and location of the coil damage
- interface with a computer in order to record product damage
- record information in a conscientious and legible fashion for the purpose of communicating this information to other co-workers who must act upon it
- transport the steel coils according to the order of production
- communicate verbally with the crane operator and other co-workers in order to insure the appropriate order of steel coil transportation
- be prepared to deal with problems which may arise from the transportation of the coils
- properly prepare the coil and connect it to several chains for transportation by the crane operator
- attend to the verbal instructions of the inspector who provides information detailing the width of the product
- understand and respond to the instructions of the inspector in order to make proper adjustments to the production equipment
- appropriately adjust the size of the passage through which the steel sheets are to be transported contingent upon verbal information received from the inspector
- receive information via verbal communications with other co-workers regarding different product dispositions and specifications, i.e., steel thickness, length, and width, as well as the order of production
- interface with a computer in order to cross-check the information received from other co-workers as to the different specifications of the product, such as thickness, length, and width, as well as the order of production
- adjust the production process of the coils according to specifications received from both co-workers and the computer
- read, understand, remember, and respond to written instructions which detail adjustments in the production process contingent upon the various coil dispositions and specifications
- obtain an identification ticket from the computer
- attach the identification ticket to the inside of the coil
- be attentive to the order of production and prepare for the incoming coil according to its specifications in order to maintain an adequate rate of production, i.e., 65 to 100 coils per shift
- attend to the spatial relationships between the self, the moving parts of production equipment, the product, and the transport vehicles

**The following information was gathered from interviews with employees and observations of the work-in-progress at the Electrogalvanized Line:**

Employees must . . .

- eventually have knowledge of chemistry and electronics in order to achieve an adequate level of job performance in this department
- be computer literate in order to control the production process
- receive, read and understand a written list of which steel coils must be processed according to the deadlines of production
- verify the information in this list via accessing the corresponding information contained in the computer
- generate from this list the exact order in which steel coils are to be processed
- determine the order of steel coil processing via several parameters and coil specifications, i.e., gauges and width
- record this information into the computer
- record the location of the coil for crane operators
- place on the coil information pertaining to the process order to be used by the crane operator
- locate the appropriate coil according to the recorded coil dimensions, i.e., schedule and stock car numbers
- send steel coils to the appropriate cranes, i.e., to cranes which have the capacity to transport the coil, otherwise extensive damage can be done to equipment that is essential to the production process
- operate a crane via remote controls in order to lift and transport the steel coils
- encode and store information relevant to the weight of the coil and the corresponding cranes which have the capacity to transport the coil
- double-check the coil dimensions
- retrieve the above information under stressful working conditions, i.e., under conditions of production deadlines, noise, a re-ordering of the production of coils, breakdowns on the production line, etc.
- carefully avoid damage to the product which can cause costly and severe down-time in the production process
- remain cooperative under conditions in which damage to the product has occurred, causing work-place stress and a re-ordering of the line of production
- locate another unprepared (i.e., unexposed) coil which meets the appropriate specifications under the conditions of coil damage
- prepare the coil by removing the protection equipment from the coil, e.g., cut the bands from the coil, remove packaging material

- use a remote control panel to operate the conveyor belt upon which the coils are placed for transportation

**The following information was gathered from interviews with employees and observations of the work-in-progress at the Coating and Shipping Lines:**

Employees must . . .

- wear protection for the face, neck, and body
- be able to drive a tow motor
- lift steel bars (30 to 50 pounds) and place them into a furnace approximately every 10 to 15 minutes
- maintain approximately 20 pounds of steel production per minute
- monitor temperature limits of the furnace to determine when it can be fed with the steel bars
- adjust the temperature to control the rate of feeding
- read and understand a list detailing the order in which coils are to be processed
- visually inspect the coil, acquiring information as to the gauge and width of the coil to insure that the correct one will be processed
- prepare coils to be unwrapped
- enter the parameters of the coil into a computer
- carefully monitor the unwrapping of the steel coil to insure that it is not done completely, i.e., part of the steel must remain wrapped
- attend to the spatial relationships between the coil and the equipment in order to move it properly via remote controls
- perform multiple tasks simultaneously, i.e., attend to the computer monitor, remote controls, and the coil at the same time
- read and interpret written information pertaining to the coil characteristics and the order of production, as well as the pieces that must be cut out from the product
- record the identification of the coil onto the coil itself and into the computer
- stop the motion of the steel coil
- weld the ends of two separate coils together
- interface with a computer to determine the proper packaging for a steel coil
- receive and give verbal communications which pertain to the packaging requirements of a coil
- have knowledge of the fact that there are approximately 400 different types of packaging specifications
- accurately identify and locate particular steel coils
- measure these coils to determine their parameters

- use information obtained from the computer, co-workers, and measurements of the coil itself in order to band and package the coil appropriately
- use coil parameters, e.g., weight, width, diameter, in order to determine the packaging requirements of each coil
- obtain knowledge of the customer's specifications from co-workers and computers in order to determine the packaging requirements of each coil
- apply this information with care and accuracy when packaging the coil according to customer specifications and regulations
- apply oil to the coil if required according to customer specifications
- receive both written and verbal instructions from co-workers pertaining to the fashion in which the coil is to be tagged and identified, i.e., the location of tag placement and how many are needed
- place identifying tags on the coil according to customer specifications, i.e., inside of the coil or outside on the packaging, depending upon the customer's needs and specifications
- package the coil correctly the first time, incorrect packaging can waste materials, decrease production time, and potentially damage customer relations
- detect any defects in the product prior to shipping
- be physically fit; packaging a coil can be a physically demanding process
- transport the coil via remote controls
- work in a team-based environment

**The following information, which pertains to the job performance and knowledge required from those at upper-level positions throughout the plant, was gathered from interviews with Subject Matter Experts, as well as from observations of the work-in-progress of these upper-level employees:**

Because approximately 45% of entry level workers are eventually employed by the Maintenance Department, AK Steel must hire individuals who are willing and able to acquire, understand, and act upon knowledge of chemistry, electronics, hydraulics, mechanics, and other areas of academic specialization. Interviews with individuals employed in this department, as well as with others, and observations of the work-in-progress of upper-level employees throughout the plant, revealed that upper-level positions in AK Steel require many of the incumbents to . . .

- have knowledge of chemistry in order to achieve an adequate level of job performance

- have knowledge of electronics in order to achieve an adequate level of job performance
- have knowledge of hydraulics in order to achieve an adequate level of job performance
- use mathematical equations
- communicate complicated problems with various machinery to other employees
- have knowledge of DC Theory, especially in order to work on cranes
- understand cause and effect in order to rapidly diagnose and repair problems with machinery for the purpose of avoiding serious losses in productivity
- be able to make quick and accurate decisions regarding machinery repair
- be willing to learn in both the classroom and on-the-job in a mentor-student relationship, i.e., an apprenticeship
- be very computer literate and adept in order to control and record the steel production process
- engage in independent trouble-shooting for equipment maintenance and repair
- understand and apply an extensive amount of knowledge learned during the apprenticeship
- think logically, i.e., in terms of cause and effect for proper diagnosis of production problems
- diagnose and correct the causes of production problems rapidly because delays in production are extremely costly
- be observant as to the different symptoms of machine wear, which signal different causes, and, consequently, different solutions as to the appropriate repair procedures
- keep multiple pieces of information in mind when solving a problem, while attending to both safety and speed
- record every delay in production greater than 4 minutes
- inspect both sides of steel coils for surface defects
- identify steel coils and place proper protection on them accordingly
- know how to manually set up the equipment necessary for the production process under the condition in which the computers break down, and use this information for adequate levels of job performance at the appropriate times
- detect flaws in the steel coils and determine what caused those flaws
- measure the distance from one defect to the other in order to see if this distance matches the parameters of the processing equipment, which serves to determine and/or eliminate one possible cause of the defect
- independently troubleshoot problems with production equipment and the product
- determine and set the number of coils to be processed
- continually interface with a computer via observing the screen monitor or recording information via the keyboard

- continually attend to spatial relationships between the product and the processing equipment
- respond to the different parameters of different steel coil products by adjusting the processing equipment either manually or via computer controls
- understand, control and operate hydraulic equipment
- operate multiple pieces of equipment while monitoring computer screens in order to control the rate of steel coil production
- interface with a computer to record all production information, including records of product tests and defects
- inspect each coil to acquire information pertaining to multiple product characteristics in order to determine how it must be processed, requiring continual flexibility of judgment
- integrate product and production variables for the purpose of determining the proper adjustments of production equipment
- change tasks when needed, requiring flexibility and multi-tasking capabilities
- engage in Quality Control procedures, continually comparing the current coil to specified product parameters
- interact in a cooperative fashion with supervisors, subordinates, co-workers and members of other departments
- observe and learn from the actions of their mentors on-the-job
- think in holistic terms, integrating the information in their department with that from others
- have leadership qualities, i.e., teach subordinates and apprentices different aspects of the steel production process
- understand how one process in one part of the plant, if adjusted, affects processes throughout the rest of the plant
- insure the product is processed according to specifications, adjusting equipment and furnace temperatures accordingly
- be willing to continually engage in verbal communications with employees at all levels of the department

## Subject Matter Experts' Descriptions of Job Incumbents:

Subject Matter Experts described job incumbents of all levels as needing to be . . .

- highly conscientious and observant of safety regulations in the absence of direct supervision
- cooperative and agreeable in order to avoid work place arguments which can slow the production process
- able to remain calm and competent, making correct decisions under potentially hazardous circumstances
- achievement motivated, i.e., high in work-drive and willing to be promoted when called upon
- high in work-drive, i.e., someone who desires to increase their own level of job performance by increasing their own level of productivity, and the productivity of their co-workers
- customer oriented, i.e., meeting the needs of the customer with perfection when packaging the final product
- able and willing to troubleshoot production problems independently
- ambitious, someone who desires to move up the job ladder in order to fill vacant positions of responsibility in the steel plant essential to its operation
- willing and eager to take on the added responsibilities that come from promotions to higher job levels -- not lazy
- resilient in that they are not easily influenced by the negative attitudes of others
- open to new experiences and ideas, largely because many of the upper level job positions in the plant require employees to attend classes in order to gain the knowledge of chemistry, electronics, and hydraulics, etc., necessary for adequate levels of job performance
- willing to learn new job skills and to acquire new information
- willing to cooperate with co-workers and supervisors
- willing to follow directions
- someone who wants to remain productive, i.e., want to increase the speed and quality of production, and acts on this desire by preparing for the next steel coil when time is available, instead of taking breaks
- disciplined and respectful of authority
- willing to follow the rules and regulations
- punctual, someone who wants to come to work and who disapproves of unauthorized absenteeism -- not a clock pusher
- have the capacity to engage in abstract reasoning for the purpose of independent troubleshooting activities, i.e., understanding the antecedents of a production problem and its consequences

- inquisitive and curious about the production process, i.e., someone who wants to learn how different departments are connected and inter-dependent
- have a high level of verbal fluency, continually communicating aspects of the production process to managers, supervisors, subordinates, and peers
- able to teach others via good social and communication skills
- holistic in their thinking, i.e., able to understand how changes in the steel production process in one part of the plant affect the product processes in the rest of the facility

## *Content Validity of the Selection Test Battery*

The above information allowed for the creation of the following table, which documents the selection tests that were chosen. These tests were chosen on the basis of the aptitudes that were determined as important for adequate levels of job performance, and the way in which those aptitudes were used in the performance of job tasks.

| Task | Aptitude | Test |
|---|---|---|
| Employees must measure steel coils to determine their parameters. They must visually inspect the coils, acquiring information as to their gauge and width to insure that the correct coils will be processed. Employees must also measure the distance from one defect in a steel coil to another in order to see if this distance matches the parameters of the processing equipment to determine the cause of the defect. | Comprehension of basic measurement and ability to apply this information. | Measuring Skills Test |
| Employees must understand and use basic, as well as complex, mathematical calculations in order to learn and apply the knowledge of hydraulics, chemistry, and electronics necessary for machine repair and maintenance. In addition, employees must understand be able to use calculations in order to translate their actions, and the steel production process, to company dollars. | Comprehension and application of addition, subtraction, multiplication and division. Comprehension and application of fractions, decimals and percentages. | SRA Arithmetic Index |

| Task | Aptitude | Test |
|---|---|---|
| Employees must read, study, understand and apply the Quality Standard Operating Procedures, or QSOPs, which detail the various requirements and procedures of different job positions. Employees must read, study, understand and apply the Job Health & Safety Analyses, which detail proper protection & safety procedures. They must also associate this information with different pieces of production equipment and different plant locations. Employees must read and interpret written information pertaining to the coil characteristics and the order of production. Employees must read texts which pertain to the principles of chemistry, hydraulics and electronics. | Reading and comprehension of written material. | SRA Reading Index |
| Employees must discriminate coils of different sizes in order to process them in the correct order. Employees must operate multiple pieces of equipment and tools by hand for the process and transportation of steel coils, as well as for the maintenance and repair of production machinery. | Size Discrimination Ability and Manual Dexterity | Work Samples Tests of Size Discrimination and Manual Dexterity |
| Employees must independently troubleshoot problems with production equipment and the steel products. Employees must think logically, in terms of cause and effect for proper diagnosis of production problems. Employees must diagnose and correct the causes of production problems rapidly because delays in production are extremely costly. | Independent Problem Solving | Work Sample Test of Independent Problem Solving |

## *Predictive Validity Study Methodology*

Over the course of the previous two years, AK Steel had contracted with the local community college to administer employee selection tests and had relied on the staff there to provide test results. These tests were proprietary selection instruments, from which each test score in percentile form was provided, plus an overall summary score in percentile form was given.

A set of test results sheets were obtained on almost 120 individuals. Mr. Mike Lehman from the Personnel Department worked with relevant supervisors to obtain job performance ratings in these same people. Consequently, we had linked data sets for just over 100 people. Almost all were male (92%). No data was provided on race or age.

Several serious research biases threatened the integrity of this study:

- This validation study was being done several years after the testing program had been put in place. Participants for the study were those people who were hired through that process. Because AK Steel used a cutoff of approximately 50th percentile, there was serious restriction of range in the predictor data.
- The policy at AK Steel is for all entry-level personnel to remain for several years in a general labor pool. Everyday, their job assignment is evaluated and modified as needed depending on the labor demands throughout the plant. They may be placed several days in one department, only to be moved after one or more days to an entirely. So, while it is desirable for the performance rating to reference a standardized job responsibilities under similar conditions, neither was present in this study.
- While the "labor pool" concept at AK Steel means that employees get a very broad base of experience, it also means they do not spent any long period with any one supervisor. When performance ratings were gathered for participants in this study, the ratings were seriously flawed because there were no supervisors for particular individuals who knew them well over a long period of time. The various supervisors who provided ratings were simply the best choice out of many possible supervisors, i.e. severe opportunity bias.
- Because AK Steel employees are promoted up through the system over the course of their employment, almost all, if not all, employees eventually hold very responsible production or maintenance positions—many of which require considerable training and on-the-job mentoring. One of the problems with this study was that participants who had taken tests as part of their hiring process had certainly been on the job long enough to learn a variety of job skills, but they had not been employed long enough to be considered for promotion into the more intellectually demanding roles. Therefore, the tests may be better predictors of very long-term success than short (1-2 year) term success.

Predictor Data: AK Steel provided us with the predictor data, i.e., test scores from a reading test, arithmetic test, measurement test, manual dexterity test and problem solving (analytical thinking test). Scores, in percentile rank format, were given for each test, along with a summary score for all the tests combined.

Criterion Data: Resource Associates, Inc. provided AK Steel with a sample job performance rating form. A group of subject matter experts discussed the content of the document, then made relevant company-specific changes in the form. Once a final document was created, Mr. Lehman from Personnel Department, sought out the most appropriate supervisor for specific individuals in order to obtain performance ratings.

The form was composed of 13 dimensions, each with accompanying behavioral descriptions. The dimensions used for performance ratings in this study were:

1. Ability to learn and reason
2. Job Skills
3. Initiative
4. Productivity
5. Quality
6. Safety
7. Teamwork
8. Reliability
9. Relationship with Supervision
10. Function under stress
11. Attendance and Tardiness
12. Advancement
13. Overall Rating

The rating scale used for these dimensions were:

1. Does not meet, or rarely meets, minimum job standards.
2. Is less than satisfactory in many respects.
3. Is satisfactory in most respects, but not all.
4. Is satisfactory in all respects.
5. Is above average, but not superior.
6. Is superior in almost all respects.
7. Is definitely superior in all respects.
8. Single best performance I have ever observed, or hope to observe.

Both data sets were sent to Resource Associates for statistical analysis and development of the final validation study report.

## *Descriptive Statistics*

Of the 121 sets of data we originally received, there were 101 actual linked sets of data that were fully usable for the analyses. The overwhelming majority were male (92%). No information was available on age or race.

As expected, test scores fell largely in the upper 50 percentile range. As one can see in the table below, the manual dexterity test and the problem solving test scores distribution were fairly widely dispersed, providing the best chance for demonstrating validity. Even in those two tests, however, the scores that did fall below the 50th percentile were only 18% of the total sample. The summary score was direct evidence of the hiring policy where no one was considered for employment below the 50th percentile. In general, these scores demonstrate a lack of dispersion, a condition which limits the opportunity for correlation analyses to demonstrate significant relationships.

| **Percent-ile Rank** | **Reading** M =76.7 SD = 18 | **Arithmetic** M = 77.9 SD = 15.8 | **Measure** M = 90.4 SD = 17.6 | **Manual** M = 72.3 SD = 18.9 | **Problem Solving** M = 81.0 SD = 15.7 | **Summary Score** M = 79.8 SD = 8.6 |
|---|---|---|---|---|---|---|
| 20 | 1% | | 1% | 1% | 1% | |
| 25 | 1% | | | | | |
| 30 | | 1% | 3% | 2% | | |
| 35 | 1% | | | 2% | 1% | |
| 40 | 3% | 2% | | 2% | 3% | |
| 45 | | 2% | | 6% | 1% | |
| 50 | 7% | 3% | | 5% | 3% | |
| 55 | 1% | 1% | | 2% | 3% | 4% |
| 60 | 14% | 9% | | 7% | 2% | 1% |
| 65 | | 10% | 6% | 3% | 3% | 5% |
| 70 | | 3% | | 5% | 2% | 19% |
| 75 | 19% | 7% | | 7% | 15% | 20% |
| 80 | | 13% | 10% | 11% | 8% | 27% |
| 85 | 30% | 15% | | 10% | 20% | 18% |
| 90 | | 11% | | 15% | 5% | 13% |
| 95 | | 9% | 21% | 15% | 21% | 2% |
| 99 | | 9% | 51% | | 1% | 2% |
| Missing | 7% | 7% | 7% | 7% | 8% | 8% |

| **Performance Rating Category** | **Learn Reason M=5.0 SD=1.2** | **Job Skills M=5 SD=1.2** | **Initiative M=4.8 SD=1.3** | **Productivity M=5.1 SD=1.3** | **Quality M=4.8 SD=1.3** | **Safety M=4.9 SD=1.4** |
|---|---|---|---|---|---|---|
| Does not / rarely meets minimum standards | -- | -- | -- | -- | -- | -- |
| Less than satisfactory in many respects | 3% | 3% | 6% | 2% | 4% | 4% |
| Satisfactory in most respects but not all | 8% | 10% | 14% | 11% | 10% | 14% |
| Satisfactory in all respects | 18% | 16% | 24% | 21% | 22% | 22% |
| Is above average, but not superior | 40% | 35% | 31% | 28% | 34% | 24% |
| Superior in almost all respects | 19% | 27% | 16% | 20% | 19% | 21% |
| Definitely superior in all respects | 11% | 9% | 9% | 19% | 7% | 15% |
| Single best performance ever observed | -- | -- | 1% | -- | 1% | -- |

| **Performance Rating Category** | **Team-work M=5.0 SD=1.5** | **Reli-ability M=5.3 SD=1.2** | **Supv. Relations M=5.2 SD=1.3** | **Stress Tolerance M=5.2 SD=1.5** | **Attend. Tardiness M=5.3 SD=1.4** | **Advance ment M=4.8 SD=1.4** |
|---|---|---|---|---|---|---|
| Does not / rarely meets minimum standards. | 2% | -- | -- | -- | -- | 1% |
| Less than satisfactory in many respects. | 3% | 2% | 5% | 6% | 2% | 3% |
| Satisfactory in most respects, but not all. | 13% | 5% | 2% | 7% | 9% | 11% |
| Satisfactory in all respects. | 17% | 19% | 18% | 19% | 22% | 33% |
| Is above average, but not superior. | 27% | 33% | 35% | 24% | 21% | 23% |
| Superior in almost all respects. | 20% | 22% | 23% | 19% | 22% | 20% |
| Definitely superior in all respects. | 17% | 18% | 16% | 23% | 22% | 9% |
| Single best performance ever observed. | 1% | 2% | 1% | 3% | 3% | 1% |

## *Test Score Validity Analysis*

Pearson Product Moment Correlations were computed to assess the validity of the tests in relation to performance ratings. In view of the large number of raters (one per ratee) and the large for potential for rater-error-variance, and given the extensive prior validity evidence for cognitive tests, one-tailed significance tests at the $p<.10$ level were used to evaluate the statistical significance of the validity coefficients.

The predictor distribution was presented in terms of percentile ranks, which represent non-linear transformations of rating data. Therefore, each percentile rank score was transformed to the underlying z-score equivalents.

The arithmetic test demonstrated validity with 9 of the criterion measures:

| | | |
|---|---|---|
| with learning: | $r = .20$ | ($p$=.02) |
| with initiative | $r = .25$ | ($p$=<.01) |
| with teamwork | $r = .21$ | ($p$=.02) |
| with job skills | $r = .13$ | ($p$=.09) |
| with productivity | $r = .12$ | ($p$=.10) |
| with safety | $r = .17$ | ($p$=.10) |
| with reliability | $r = .15$ | ($p$=.06) |
| with stress tolerance | $r = .13$ | ($p$=.10) |
| with composite rating | $r = .17$ | ($p$=.06) |

The summary aptitude score provided by the testing service demonstrated validity with 5 of the criterion measures:

| | | |
|---|---|---|
| with learning | $r = .16$ | ($p$=.05) |
| with initiative | $r = .15$ | ($p$=.07) |
| with teamwork | $r = .22$ | ($p$=.01) |
| with job skills | $r = .13$ | ($p$=.10) |
| with productivity | $r = .14$ | ($p$=.08) |

The measurement test demonstrated validity with 3 of the criterion measures:

| | | |
|---|---|---|
| with teamwork | $r = .20$ | ($p$=.02) |
| with supervisory relations | $r = .17$ | ($p$=.04) |
| with job skills | $r = .15$ | ($p$=.06) |

The problem solving test demonstrated validity with 2 of the criterion measures:

| | |
|---|---|
| with learning | $r = .16$ ($p$=.05) |
| with productivity | $r = .13$ ($p$=.10) |

The average of two tests (arithmetic and reading) demonstrated validity with 2 criterion measures:

| | |
|---|---|
| with initiative | $r = .12$ ($p$=.10) |
| with teamwork | $r = .18$ ($p$=.03) |

## *Summary*

These results provide empirical evidence that mental aptitude is related to job performance at AK Steel. People who score higher on the aptitude tests tend to be rated higher by their supervisors on most of the individual cognitive tests. While the absolute values of the correlations were modest, there were positive and statistically significant relationships. Given that there were so many research biases in the data and the difficulties related to the criterion data collection process, we feel that these data provide substantial evidence for the validity of aptitude measures to predict job performance.

The criterion measures most often found to be related to the aptitude scores were: learning, teamwork, job skills and productivity. Three of these dimensions seem logically related to aptitude. For some people, the relationship of aptitude and teamwork may seem odd and unexpected, however, similar selection test validation studies have shown repeatedly that successful teams are typically staffed by bright, mentally sharp people.

Given that several of the criterion measures were not related to any of these predictors: quality, attendance, and potential for advancement, we can hypothesize that personal style is more logically related to behavioral or style components of job performance (e.g., supervisory relations, attendance, reliability, teamwork, and stress tolerance. Several of these dimensions that were not clearly related to the predictors are more to be influenced by personality factors, not cognitive factors.

Use of personality measures in addition to aptitude measures typically adds about 10% of incremental accountable variance. In other words, the job performance that is predictable by aptitude measures can be substantially improved by the addition of personality measures. It is understood that AK Steel plans to address this issue in the next phase of selection test program development.

The fact that not all the criterion measures were related to the predictors affords ample room for the addition of other measures and / or alternative aptitude measures. The tests

used in this selection application were satisfactory in terms of demonstrating job-related validity, though there may be other tools for measuring cognitive ability which are better suited to production environments. If any future validation study is undertaken, we strongly recommend that single raters provide ratings for multiple incumbents, so as to reduce between-rater variance in ratings (which will lower the validity coefficients).

Employee Selection

•

Technical Skills Assessment

•

Managerial Assessment

•

Training & Employee Development

•

Organizational Development

•

Conflict Resolution

•

Team Building

•

Organizational Culture Assessment

# EMPLOYEE SELECTION TESTING

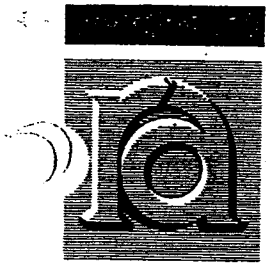
# VALIDATION STUDIES

**conducted by**

## Resource Associates, Inc.

resource associates, inc.

7044 Lake Bluff Court Knoxville, TN 37920 Phone: (865) 609-9359 (800) 840-4749 FAX: (865) 609-1170



Employee Selection

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December 1999

August 1997

May 1997

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7044 Lake Bluff Court Knoxville, TN 37920 Phone: (865) 609-9359 (800) 840-4749 FAX: (865) 609-1170

# PREDICTIVE SELECTION TEST VALIDATION STUDY

## of Resource Associates' Aptitude and Personality Tests For Entry Level Workers at AK Steel, Middletown, Ohio

**September 30, 1999**
With Updated Adverse Impact Analysis December 31, 1999

## *Overview of This Study*

This document reports the results of a predictive selection test validation study for the entry level employees at AK Steel in Middletown, Ohio, undertaken as a third phase of a on-going research effort. People who had been hired through the normal testing process over the past two years were the basis for this sample. Supervisory ratings were collected to form the criterion measures. Validity coefficients were computed on the test scores and performance ratings.

Over the past two years, a multiple cutoff scoring strategy had been in place to categorize candidates as either "Qualified" or "Not Qualified" for further evaluation in the hiring process. These cutoff were: (a) 60th percentile on a composite score for aptitude tests, (b) a cutoff of 35$^{th}$ percentile on three of the more valid personality measures (Conscientiousness, Agreeableness, and Emotional Stability), and (c) a cutoff of about the 10$^{th}$ percentile on the personality dimensions that achieved less validity (Work Drive, Customer Service Orientation, Extroversion, and Openness to New Experience). Having instituted cutoffs created restriction of range – a situation that makes identifying validity more difficult.

The results in this study were supportive of testing. All the aptitude tests were shown to have good correlations with the job performance ratings, particularly those related to learning, reasoning, job skills, quality, safety, etc. Likewise, the personality measures were all related to job performance ratings, particularly those related to interactions and attitudes toward work. In summary, this study provides validity evidence for AK Steel to continue testing job candidates.

# *Overview of Previous Validation Work*

Two years ago, a thorough job analysis was conducted to produce content validity evidence for the recommended tests. From the job analysis, content validity demonstrated job-relatedness of the following tests. These tests were judged to be good assessments to distinguish individuals with a high probability job success from those with lower probabilities at AK Steel.

The tests that have been used for hiring at AK Steel are:

- Resource Associates Pattern Series Test
- Resource Associates Mechanical Reasoning Test
- Resource Associates Math Test for Industry
- Resource Associates Reading for Production Workers Test
- Resource Associates 3-D Visual Spatial Reasoning Test
- Resource Associates Form Pattern Comprehension Test
- Resource Associates Industrial Personal Style Inventory (version C6C)

# *Procedures for This Study*

## Identifying a Sample

Since AK Steel has been using Resource Associates' aptitude tests and personality measures to assist with hiring decisions for the past two years, a large number tests scores had accumulated. People who were hired during this time period provided the sample for this study. A target sample of approximately 200 was set – people who had been on the job at least six months. This number was sufficient to provide statistical power for the analyses and it was not so overwhelming that it would unduly burden the staff in human resources to assist in job performance ratings data collection.

## Gathering Test Score Data

The testing process took place when applicants were being evaluated for hire. People were motivated to perform well. Test scores were readily available as part of the test score database.

## Gathering Performance Rating Data

At AK Steel, new employees are put into a labor pool from which, on a daily basis, employees are drawn to staff various parts of the mill. Therefore, employees typically work in many different locations for many different supervisors. Consequently, for the purposes of validating a selection testing system, it is particularly difficult to identify employees who have spent enough time working for one supervisor. This system makes it difficult to identify supervisors who have spent enough time with particular employees so that reasonable job performance ratings could be collected.

Staff from the Human Resources Department identified the several supervisors who had spent the most time with each of the employees in the sample. These supervisors were then contacted and asked to provide job performance ratings.

The criterion used in this study represent the key dimensions of performance for entry-level workers at AK Steel. A Performance Rating Form which was developed as part of a previous validation study provided behavioral indicators explaining each dimension. The Human Resources staff representative asked each supervisor to educate himself on the form, then use it as a guide to providing performance ratings on the people in this sample.

The form was composed of 13 dimensions, each with accompanying behavioral descriptions. The dimensions used for performance ratings in this study were:

- Ability to Learn and Reason
- Job Skills and Proficiency
- Openness to New Learning
- Productivity
- Quality of Work
- Safety
- Teamwork
- Relationships with Associates
  Relationship with Supervision
- Dependability and Reliability
- Attendance and Timeliness
- Functioning Under Stress
- Willingness to Promote
- Overall Rating

The rating scale used for these dimensions were:

1. Does not meet, or rarely meets, minimum job standards.
2. Is less than satisfactory in many respects.
3. Is satisfactory in most respects, but not all.
4. Is satisfactory in all respects.
5. Is above average, but not superior.
6. Is superior in almost all respects.
7. Is definitely superior in all respects.
8. Single best performance I have ever observed, or hope to observe.

## Data Analyses

Completed test answer sheets were forwarded to Resource Associates where they were scored and entered into a computerized database. Industrial Psychologists at Resource Associates conducted the statistical analyses using SPSS (Statistical Package for the Social Sciences).

# *Results of the Validation Study*

## Descriptive Statistics for the Validation Sample

Of a total of 189 sets of data formed the basis for this study: 88% were less than 40 years old while 12% were 40 or more years old; 97% were White, 2% were Black, and 1% fell in "other racial group." Also, males comprised 95% of the sample while females comprised 5%.

## Validity Analyses

Pearson product moment corrections were computed to assess validity of the tests in relation to performance ratings. One-tailed significance tests at the .05 level of significance were run to evaluate whether there was a valid relationship between the test scores (predictors) and the performance ratings (criterion measures).

A correlation coefficient is interpreted as a "validity coefficient." Validity is demonstrated when a positive correlation exists between the test score and the criterion measure. Only those correlations that are strong enough (ones that are identified as significant) are deemed to reflect practical consideration. Among scientists, if a statistic is viewed as occurring by chance less than 5 times out of 100 similar trials, then it is judged to be significant ($p<.05$). If the significance is greater than .05 then the statistic is viewed as reflecting only random error.

### *Validity Analyses of the Aptitude Measures*

As shown in the following table, a very solid set of validity coefficients emerged from this data set. All of the aptitude tests demonstrated significant correlations with a majority of the criterion measures. Where some tests were not valid predictors of a job performance criteria, it was generally an illogical relationship. For example, we see that mechanical reasoning is not a valid predictor of relationships with co-workers.

The most substantial validity coefficients were generated from the composite aptitude score in relation to the various performance dimensions where validity coefficients ranged from .23 to .36. Validity for the composite aptitude score with the average performance rating was .35. These results provide solid empirical evidence that use of aptitude test scores are good predictors of future job performance.

**Table 1**
**Validity Coefficients for the Aptitude Measures**

| Rating Dimension | Mechanical Reasoning Test | Industrial Math Test | Industrial Reading Test | Abstract Reasoning Test |
|---|---|---|---|---|
| Ability to Learn | .20** | .28** | .21** | .24** |
| Openness to New Learning | .19** | .22** | .16** | .21** |
| Quality of Work | .21** | .20** | .15* | .15* |
| Job Skills Competencies | .18** | .21** | .25** | .18** |
| Productivity | .20** | .20** | .16** | .13* |
| Safety | .24** | .19** | .17** | .16** |
| Dependability | .25** | .27** | .15* | .19** |
| Willingness to Promote | .23** | .15* | .16** | .16** |
| Stress Tolerance | .19** | .27** | .25** | .22** |
| Attendance and Timeliness | .24** | .22** | .25** | .19** |
| Relationships with Supervisors | .16** | .25** | .19** | .17** |
| Relationships with Co-Workers | .09 | .17** | .13* | .18** |
| Teamwork | .20** | .23** | .18** | .22** |
| Overall Rating | .22** | .22** | .18** | .18** |
| Average Rating | .25** | .23** | .25** | .21** |

* p < .05 significance ** p < .01 significance

| Rating Dimension | 3-D Reasoning Test | Form Pattern Test | Average of All Six Standardized Test Scores |
|---|---|---|---|
| Ability to Learn | .19** | .24** | .39** |
| Openness to New Learning | .11 | .14* | .28** |
| Quality of Work | .14* | .15** | .28** |
| Job Skills Competencies | .25** | .20** | .36** |
| Productivity | .15** | .20** | .30** |
| Safety | .19** | .15** | .30** |
| Dependability | .20** | .15** | .32** |
| Willingness to Promote | .16** | .18** | .31** |
| Stress Tolerance | .17** | .11 | .32** |
| Attendance & Timeliness | .16** | .11 | .28** |
| Relationships with Supervisors | .15** | .12 | .27** |
| Relationships with Co-Workers | .13* | .13* | .23** |
| Teamwork | .12* | .15** | .30** |
| Overall Rating | .15** | .20** | .33** |
| Average Rating | .18** | .17** | .35** |

* < .05 significance ** < .01 significance

## *Validity Analyses of the Personality Measures*

This analysis also produced a strong pattern of validity coefficients for the personality measures. While all of the personality factors were valid predictors of multiple job performance criteria, it appears that highly desirable employees are agreeable, cordial, friendly, cooperative, flexible, willing to be trained, level-headed, stress resistant, hard working, and willing to be helpful.

**Table 2**
**Validity Coefficients for the Personality Measures**

| Rating Dimension | Conscientiousness | Emotional Stability | Agreeableness | Openness |
|---|---|---|---|---|
| Ability to Learn | .07 | .17** | .19** | .19** |
| Openness to New Learning | .15* | .22** | .20** | .24** |
| Quality of Work | .24** | .26** | .25** | .22** |
| Job Skills Competencies | .19** | .22** | .24** | .26** |
| Productivity | .12* | .19** | .18** | .17** |
| Safety | .17** | .22** | .24** | .25** |
| Dependability | .17** | .25** | .26** | .23** |
| Willingness to Promote | .23** | .30** | .28** | .24** |
| Stress Tolerance | .12* | .20** | .19** | .17** |
| Attendance & Timeliness | .14** | .19** | .19** | .16** |
| Relationships with Supervisors | .20** | .29** | .28** | .21** |
| Relationships with Co-Workers | .11* | .19** | .23** | .12** |
| Teamwork | .17** | .25** | .23** | .26** |
| Overall Rating | .19** | .26** | .25** | .23** |
| Average Rating | .22** | .30** | .28** | .27** |

* p < .05 significance p < .01 significance

| Rating Dimension | Extroversion | Work Drive | Customer Responsiveness |
|---|---|---|---|
| Ability to Learn | .19** | .07 | .15* |
| Openness to New Learning | .16** | .15* | .17** |
| Quality of Work | .24** | .22** | .18** |
| Job Skills Competencies | .23** | .20** | .23** |
| Productivity | .18** | .13* | .12 |
| Safety | .19** | .15** | .23** |
| Dependability | .19** | .18** | .20** |
| Willingness to Promote | .20** | .22** | .18** |
| Stress Tolerance | .15* | .09 | .14* |
| Attendance & Timeliness | .13* | .14* | .09 |
| Relationships with Supervisors | .22** | .18** | .23** |
| Relationships with Co-Workers | .23** | .09 | .14* |
| Teamwork | .24** | .17** | .18** |
| Overall Rating | .22** | .19** | .19** |
| Average Rating | .24** | .23** | .22** |

p < .05 significance ** p< .01 significance

For the past two years, AK Steel has used a higher cutoff (40th percentile) for the personality variables that were shown to be particularly valid in the previous validation study: Conscientiousness, Emotional Stability, and Agreeableness. These three variables were combined to form a composite score called PERSONALITY 1.

The remaining four variables: Openness to New Experience, Work Drive, Extroversion, and Customer Service Orientation, achieved less consistent pattern of validity. They were combined to forma composite score called PERSONALITY 2. Therefore, a lower cutoff (10th percentile) was used in the scoring algorithm for making "Qualified" vs. "Not Qualified" decisions.

Shown below are validity coefficients for the two composite scores. As can be seen in this set of validity coefficients, both composite scores produced substantial sets of validity coefficients, so each could be used with confidence for making selection decisions.

**Table 3**
**Validity Coefficients for Two Personality Composites**

| Rating Dimension | PERSONALITY 1 Conscientiousness Emotional Stability & Agreeableness | PERSONALITY 2 Openness to New Experience, Work Drive, Extroversion, and Customer Service Orientation |
|---|---|---|
| Ability to Learn | .15* | .16** |
| Openness to New Learning | .20** | .18** |
| Quality of Work | .26** | .21** |
| Job Skills Competencies | .23** | .25** |
| Productivity | .17** | .15* |
| Safety | .22** | .22** |
| Dependability | .24** | .20** |
| Willingness to Promote | .29** | .21** |
| Stress Tolerance | .18** | .13* |
| Attendance & Timeliness | .18** | .11 |
| Relationships with Supervisors | .28** | .22** |
| Relationships with Co-Workers | .19** | .14* |
| Teamwork | .23** | .19** |
| Overall Rating | .25** | .21** |
| Average Rating | .29** | .24** |

* $p < .05$ significance  ** $p < .01$ significance

# *EEOC Analyses*

Because the AK Steel testing system that used the tests evaluated in this project had been in operation for about two years, and because a cutoff score had been used to identify the most promising applicants, we have the basis on which to assess adverse impact.

Adverse impact is defined as a hiring rate for minority groups that is substantially less than that for the majority group. The EEOC defines substantially less as 'less than 80% of the hiring rate for majority group.' This is known as the 4/5ths (80%) rule.

As seen in the tables on the following pages there is evidence of adverse impact for the various minority groups. Readers should bear in mind, however, that if adverse impact is shown, the company bears the burden of demonstrating validity. If this condition is met, then use of the tests is legal.

**Table 4**
**Entry-Level Hires Pass Rates for 1997 through 1999**

| | | Qualified | Not-Qualified |
|---|---|---|---|
| **1997** | | | |
| Total Tested | 870 (100%) | 314 (36%) | 556 (64%) |
| | | | |
| **1998** | | | |
| Total Tested | 2043 (100%) | 711 (35%) | 1332 (65%) |
| | | | |
| **1999** | | | |
| Total Tested | 1158 (100%) | 466 (40%) | 692 (60%) |

## Table 5
## Pass Rates for Entry Level Hires 1997 – 1999
## By Racial Group

| 1997 | | | | | |
|---|---|---|---|---|---|
| | Total | Qualified | Not-Qualified | 80% Rule | Evidence of Adverse Impact |
| Whites | 614 (86.7%) | 235 (38%) | 379 (62%) | — | |
| Blacks | 63 (12.2%) | 13 (21%) | 50 (79%) | 55% | Yes |
| Hispanic | 3 | 0 | 3 (100%) | NA | |
| Oriental | 2 | 0 | 2 (100%) | NA | |
| American Indian | 2 | 0 | 2 (100%) | NA | |
| Other | 2 | 1 (50%) | 1 (50%) | NA | |

- In 1997, we had demographic information on 686 candidates.
- Where NA is given as the 80% Rule, the numbers are too small to make comparisons.
- The 80% Rule shows the result of Minority Pass Rate divided by the Majority Pass Rate.

| 1998 | | | | | |
|---|---|---|---|---|---|
| | Total | Qualified | Not-Qualified | 80% Rule | Evidence of Adverse Impact |
| Whites | 1775 | 674 (38%) | 1101 (62%) | — | |
| Blacks | 194 | 10 (5%) | 184 (95%) | 13% | Yes |
| Hispanic | 12 | 1 (8%) | 11 (92%) | NA | |
| Oriental | 3 | 0 (0%) | 3 (100%) | NA | |
| American Indian | 11 | 4 (36%) | 7 (64%) | NA | |
| Other | 4 | 1 (25%) | 3 (75%) | NA | |

- In 1998, we had demographic information on 1073 candidates.

**Table 5 (continued)**

| 1999 | | | | | |
|---|---|---|---|---|---|
| | Total | Qualified | Not-Qualified | 80% Rule | Evidence of Adverse Impact |
| Whites | 952 | 414 (44%) | 538 (56%) | --- | |
| Blacks | 99 | 13 (13%) | 86 (87%) | 30% | Yes |
| Hispanic | 7 | 1 (14%) | 6 (86%) | NA | |
| Oriental | 4 | 0 (0%) | 4 (100%) | NA | |
| American Indian | 3 | 1 (33%) | 2 (66%) | NA | |
| Other | 9 | 3 (33%) | 6 (66%) | NA | |

- NOTE: In 1999, we had information on race for 1073 candidates.
- Where NA is given as the 80% Rule, the numbers are too small to make comparisons.
- The 80% Rule shows the result of Minority Pass Rate divided by the Majority Pass Rate.

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Since the previous analysis provided evidence that there is adverse impact in this test battery, the next question concerns what specific tests have adverse impact for which groups. In the following tables, data is presented to show where significant differences exist between groups.

## Analysis of Test Score Differences by Race

While there were five racial groups represented in the sample, Whites outnumbered all other groups by far. This type of imbalance makes the outcome of statistical analyses suspect. Since the numbers are so small for American Indians, Orientals, and Hispanics, we will focus our attention only on Whites and Blacks.

As seen in the table below, Whites score higher than Blacks on all of the aptitude tests although they scores about the same as Whites on the personality dimensions.

**Table 8**
**White vs. Black Test Score Differences**

| Predictor | Blacks | | Whites | | *t* value | Signif-icance |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **Aptitude Tests** | | | | | | |
| Pattern Series Test | 20.3 | 7.5 | 24.4 | 6.8 | -3.77 | .000** |
| Reading Comprehension | 20.8 | 16.2 | 23.9 | 6.1 | -3.29 | .001** |
| Mechanical Reasoning | 25.8 | 6.6 | 33.94 | 7.7 | -7.62 | .000** |
| Industrial Math | 10.0 | 4.8 | 15.0 | 5.4 | -6.51 | .000** |
| 3-D Reasoning | 17.3 | 7.7 | 24.2 | 8.9 | -4.92 | .000** |
| Form Pattern Comprehension | 9.9 | 2.8 | 12.1 | 3.6 | -4.86 | .000** |
| **Personality Dimensions** | | | | | | |
| Conscientiousness | 4.19 | .56 | 4.31 | .47 | -1.62 | .11 |
| Teamwork / Agreeableness | 4.02 | .43 | 4.05 | .35 | -.52 | .61 |
| Emotional Stability | 4.04 | .57 | 4.17 | .44 | -1.49 | .14 |
| Extroversion | 3.88 | .54 | 3.94 | .48 | -.72 | .48 |
| Openness to New Experience | 3.99 | .47 | 4.01 | .43 | -.22 | .84 |
| Work Drive | 3.99 | .58 | 3.94 | .59 | .59 | .55 |
| Customer Service | 4.12 | .49 | 4.23 | .35 | -.54 | .13 |

* Significance (alpha) refers to the probability that the two means (Black mean versus White mean) are actually the same. As with the validity coefficients, where the significance is less than .05, we interpret the data as showing a real difference between the two groups. Where the significance is not less than .05, then the differences are viewed as random error.

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# *Conclusions and Recommendations*

This study utilized test scores that had been collected over the past two years as a result of the normal hiring process for people into entry-level jobs. Of the people who had been hired, a sample was selected and performance ratings obtained from supervisors. Validity analyses produced solid results: both aptitude tests and personality measures demonstrated validity for job performance in entry-level jobs.

Some adverse impact is present. [redacted]

However, the EEOC Guidelines indicate that where a company has demonstrated validity, the test battery may continue to be used.

The company wants to place a high degree of emphasis on cognitive ability in the hiring process because almost all the people hired into entry-level jobs will eventually be placed in more cognitively demanding positions that require substantial amount of classroom training. In our professional opinion, we do not feel that there are any alternative aptitude tests that would be as valid as the ones used in this study and that would have less adverse impact. Likewise, the personality inventory used in this study represents current research in the field of Industrial Psychology and we cannot recommend any other predictors that would generate this type of valid predictor information yet have less adverse impact.

The company wishes to adjust the scoring algorithm slightly to allow (a) opportunity for a higher pass rate for minorities, (b) as long as the overall pass rate approaches 50%.

The new scoring mechanism is based on a cutoff of (a) 50$^{th}$ percentile cutoff on overall cognitive aptitude, and (b) 20$^{th}$ percentile cutoff on overall personality. This new approach to scoring was put in place October 1999.